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"IOT BASED FOOD COLD STORAGE MONITORING AND CONTROLLING SYSTEM"

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Abstract: Tricholoma matsutake (T. matsutake) is a special type of fungus known as "the king of bacteria", and has a very high economic value. However, it is also very difficult to transport due to its corruptibility. Therefore, tracing and tracking the quality and safety of T. matsutake in the cold chain is very important and necessary. Based on changes in the cold chain, environmental parameters determine the safety of T. matsutake is a viable option. This paper developed and tested a real-time monitoring traceability system (RM-TM) using emerging Internet of Things (IoT) technologies for monitoring the cold chain logistics environmental parameters of T. matsutake. Finally, system testing and evaluation have shown that RM-TM can track and monitor temperature, humidity, oxygen and carbon dioxide fluctuations in the cold chain in real-time. In addition, the collected data can be used to increase the transparency of cold chain logistics and to more effectively control quality, safety, and traceability. In general, the system evaluation results show that it is reliable and meets the requirements of users.

In the Energy Management system, the main constraints are accurate data, energy monitoring and implementation of visual data for consumers. This Project is intended in designing a system at home or industry which monitors the temperature consumption of cold storage, which is designed to calculate the total energy consumption. A server will be created with appropriate channels to monitor the energy consumption from each of the devices respectively. These data will be uploaded to the server at the monitoring end. Considering all this data, an individual energy load profile for each of the devices is displayed on the web-page.

Keywords: Transmitter, Receiver, Antenna, Fading, Peak to average power ratio (PAPR), Bit error rate (BER), Symbol error rate (SER), Frame error rate (FER), Inter carrier interference (ICI), Inter symbol interference (ISI), Cyclic prefix (CP), Maximal ratio combining (MRC), Maximum sum rate and Minimum error rate etc.

I. INTRODUCTION

The **"IOT BASED FOOD COLD STORAGE MONITORING AND CONTROLLING SYSTEM"** project revolutionizes the cold storage industry by introducing an automated solution to ensure the consistent preservation of frozen food. With the increasing demand for quality and safety in food storage, the system addresses crucial challenges by leveraging IoT technology. By controlling equipment like solenoid valves and air conditioners based on preset timers, the system minimizes human intervention, reducing the risk of temperature fluctuations that could lead to spoilage. Furthermore, real-time monitoring of environmental parameters such as temperature and humidity adds an extra layer of precision, enhancing food safety protocols and enabling efficient energy management. As a result, this project not only streamlines operations in cold storage facilities but also contributes to minimizing food wastage and optimizing resource utilization.

Incorporating cutting-edge IoT technologies, the **"IOT BASED FOOD COLD STORAGE MONITORING AND CONTROLLING SYSTEM"** project provides a comprehensive solution for the challenges faced by the cold storage industry. By automating temperature control processes and offering real-time monitoring capabilities, the system ensures the preservation of frozen food at optimal conditions. Additionally, the integration of cloud-based data storage facilitates remote access and management, enabling stakeholders to monitor operations from anywhere. This project not only enhances food safety and quality but also promotes sustainability by reducing energy consumption and minimizing food wastage, marking a significant advancement in the efficiency and effectiveness of cold storage operations.

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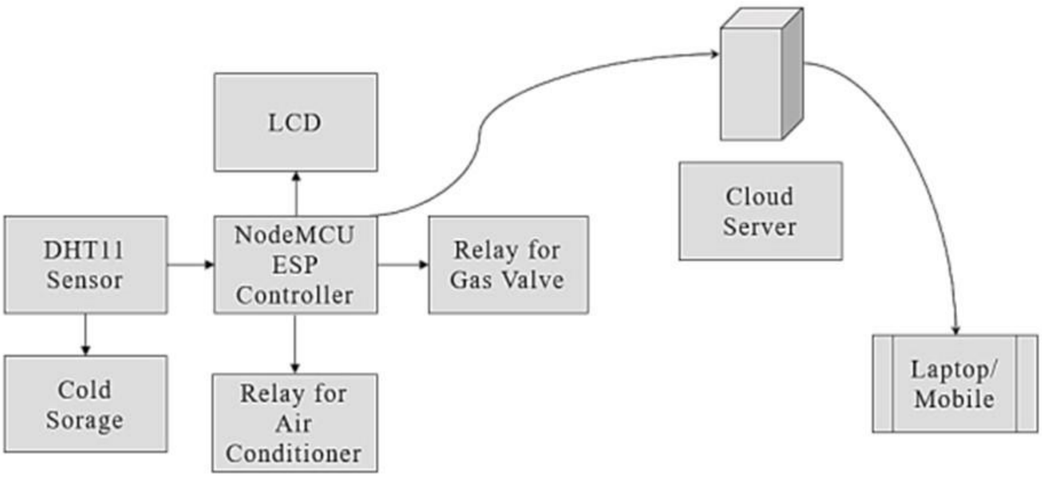
II. PROJECT OBJECTIVE

1. To control solenoid valve for ammonia gas
2. To control air conditioner unit
3. As per timer, both systems should work
4. Both systems manage online – It has timer values to set it ON and as per timer over the system will turn OFF
5. Temperature and humidity parameters should monitor online – If power cut occur time should be noted till the power
6. Data must be seen on the cloud server

III. LITERATURE REVIEW

The literature survey encompasses various studies highlighting innovative approaches in temperature monitoring and food storage management. Budijono and Felita's study emphasizes the significance of temperature control in food quality maintenance, employing ESP32 to monitor freezer performance continuously. The integration of Wi-Fi connectivity enables real-time data transmission to a cloud database, facilitating remote monitoring and preventive maintenance measures. Additionally, Bamanikar et al.'s exploration of smart refrigerators underscores the transformation of conventional refrigeration units into IoT-enabled systems, enhancing user accessibility and food preservation efficacy. Similarly, Murali et al. 's IoT-based smart refrigerator introduces automated inventory management through weight detection, streamlining grocery ordering processes and optimizing resource utilization. Witjaksono et al.'s investigation focuses on utilizing IoT for food quality and safety monitoring, emphasizing the potential of smartphone applications in disseminating real-time food condition data to consumers and supervisors. These studies collectively underscore the evolving landscape of food storage technologies, emphasizing the integration of IoT for enhanced efficiency, convenience, and food safety.

IV. BASIC BLOCK DIAGRAM



1. For monitoring the temperature DHT11 temperature sensor is used.
2. Temperature sensor is connected to the ESP Controller.
3. Temperature sensor records the data which is stored on cloud server to monitor with respect to date and time as well as in the form of graph. So, the temperature of cold storage is continuously monitored through IoT.
4. Cloud server provides wireless communication which is also connected to ESP Controller.

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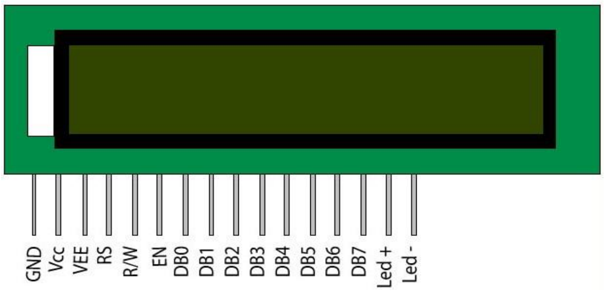
V. COMPONENTS

DHT11 Sensor

This sensor measures the humidity and temperature inside the cold storage. The data it collects is crucial for maintaining the optimal conditions for the stored food.

16 x 2 LCD Display

This display shows real-time data received from the NodeMCU ESP Controller, such as the current temperature and humidity inside the cold storage.



Relay Module(Gas Valve and Air Conditioner)

- This relay controls the flow of gas within the refrigeration system. Signals from the NodeMCU ESP Controller regulate the opening and closing of the gas valve, enabling precise control over the cooling process.
- This relay is responsible for controlling the operation of the air conditioner unit within the cold storage. Signals from the NodeMCU ESP Controller dictate when the air conditioner should be activated or deactivated to maintain the desired temperature.

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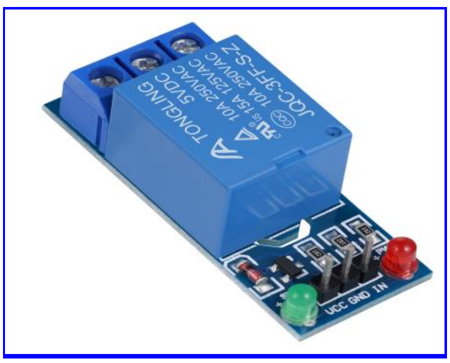

NodeMCU ESP Controller

Serves as the central hub for data processing and control within the system, receiving input from sensors and sending commands to actuators. It facilitates communication with the cloud server, enabling remote monitoring and management of the cold storage environment. With its Wi-Fi capabilities, it provides seamless connectivity for real-time data transmission and control, ensuring optimal operation and efficiency of the cold storage

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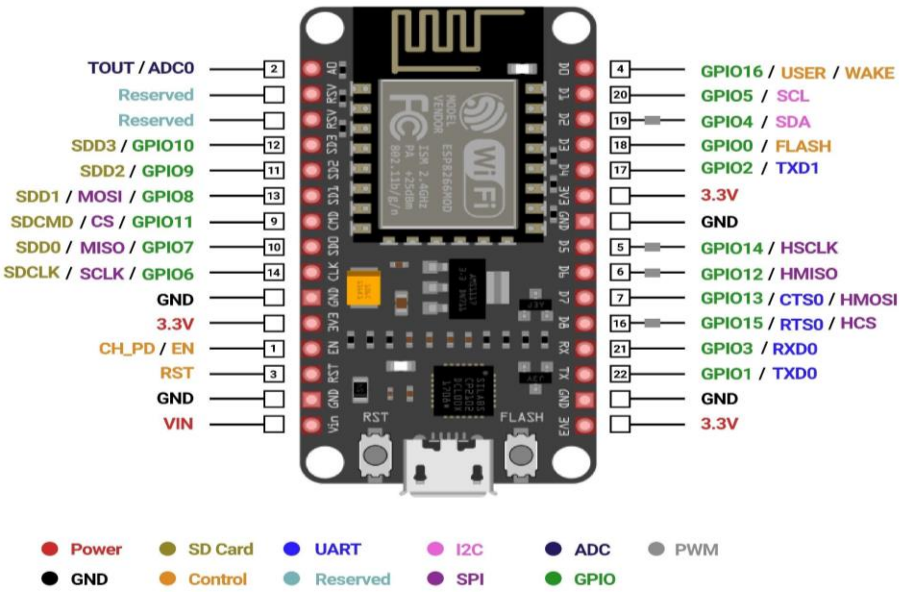
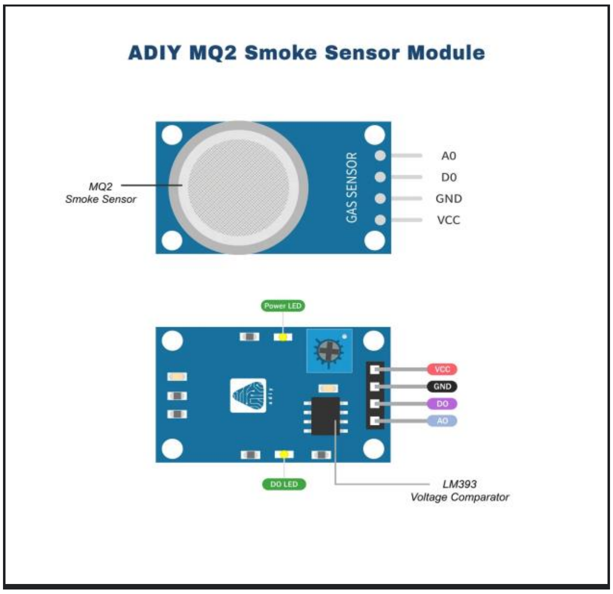


Gas Sensor

Gas Sensor: This sensor detects the presence of gas in the environment. If a gas leak is detected, it sends a signal to the NodeMCU ESP Controller, which then controls the relay for the gas valve to stop the flow of gas.



Cold Storage

This is where the food is stored. The conditions inside this unit, such as temperature and humidity, are constantly monitored by the DHT11 sensor.

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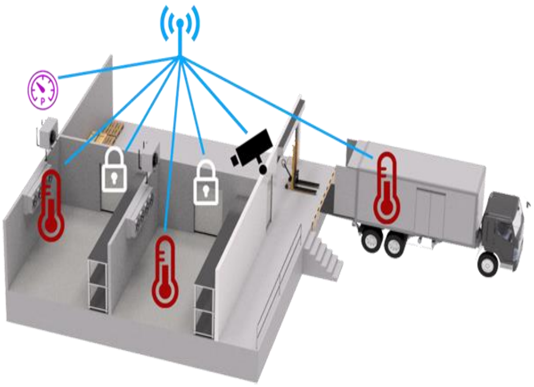
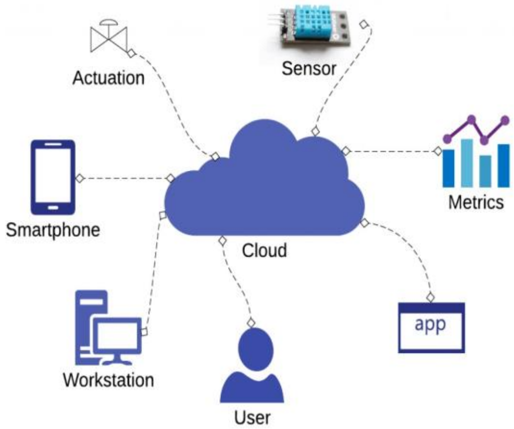


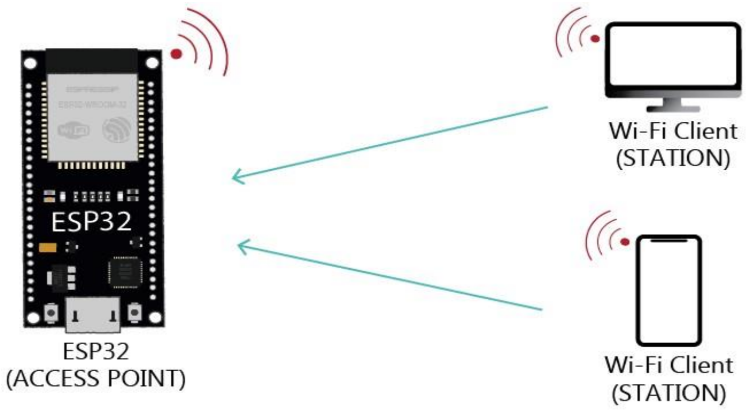
Cloud Server

The NodeMCU ESP Controller sends the data it collects and processes to this cloud server. This allows for remote monitoring and control of the system.



Laptop/Mobile

These devices are used to access the data on the cloud server. This allows users to remotely monitor and control the cold storage conditions.



VI. ADVANTAGE

1. Maintaining consistent temperature and humidity levels to prevent food spoilage and contamination.
2. Optimizing energy usage and reducing food wastage lead to significant cost savings over time.
3. Enabling remote monitoring and control of cold storage conditions, providing convenience and flexibility to users.

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4. Automation of temperature control processes and data management streamlines operations, increasing overall efficiency.
5. Meeting regulatory requirements for food storage conditions by ensuring accurate and continuous monitoring of environmental parameters.

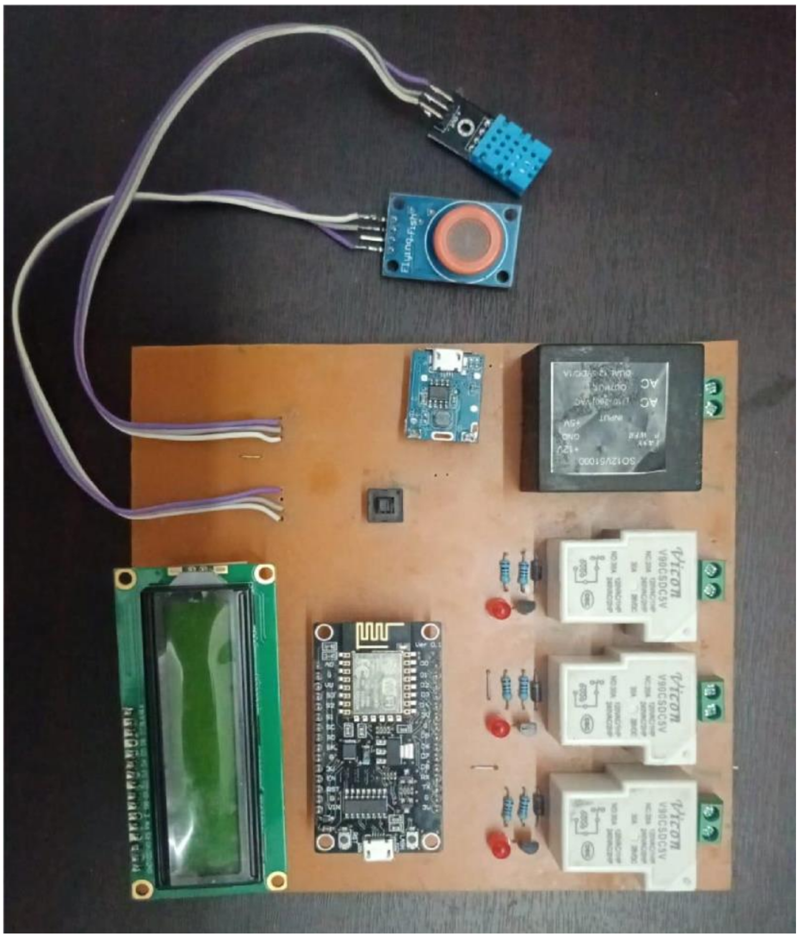
VIII. APPLICATION

1. Ensuring optimal conditions for storing perishable food items like Tricholoma matsutake to maintain quality and safety.
2. Allowing users to monitor and adjust cold storage conditions from anywhere using laptops or mobile devices.
3. Optimizing energy consumption through automated control of equipment like air conditioners based on real-time temperature data.
4. Identifying potential issues in the cold storage system early through continuous monitoring, reducing downtime and maintenance costs.
5. Enhancing traceability and accountability by recording and sharing temperature data in the cloud server, improving overall food safety standards.

VIII. FUTURE SCOPE

1. Implementing AI algorithms to analyze real-time data from sensors for predictive maintenance and optimization of cold storage operations.
2. Utilizing blockchain to create immutable records of temperature and humidity data, enhancing transparency and traceability throughout the cold storage supply chain.
3. Deploying edge computing devices to process data locally in the cold storage facility, reducing latency and improving responsiveness for critical temperature control actions in real-time.

IX . ACTUAL MODEL



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